REMARKS/ARGUMENTS

Status of Claims

Claims 1 through 10 are pending, with claims 1 and 10 being independent. Non-elected Claims 11-17 have been cancelled, without prejudice. All pending claims have been amended.

Overview of the Office Action

Claims 1-10 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Natori in view of Speakman and Sakamoto.

Summary of subject matter disclosed in the specification

The following descriptive details are based on the specification. They are provided only for the convenience of the Examiner as part of the discussion presented herein, and are not intended to argue limitations which are unclaimed.

A solution jetting device is used for forming an electronic circuit on a base member by electrostatically jetting liquid drops of a solution from a nozzle 21 which can have an inner diameter as small as 0.1μm. To electrostatically jet liquid drops from nozzle 21, the solution is charged with a voltage of an arbitrary waveform that is applied by an electrode 28 directly to the solution which is supplied to nozzle 21. See Specification, page 35.

The inner diameter of the nozzle is made to be very small. This serves to concentrate the electric field and enhances the electrostatic jetting of the liquid drops. See pages 6-8 , 38 and 45 of the specification. The concentrated electric field applied directly to the solution and the small diameter of the nozzle provide for stably jetting fine liquid drops which can have a volume smaller than 1 pico-liter or 100 femto-liter. See Specification, page 8, lines 3-16.

Descriptive summary of the prior art

NATORI

Natori discloses a method for manufacturing an electric circuit in which droplets of a conductive solution are forced from a nozzle 211 in response to a mechanical force produced as a result of energization of a piezoelectric component (PZT) 240. See Natori, computer translation, paragraph [0018], lines 16-21; FIGS. 9 and 10. Alternatively, Natori discloses a heater causing the solution to expand and bleed from the nozzle. See Natori, paragraph [0019].

SPEAKMAN

Speakman discloses a "drop-on-demand" printing process in which the use of a digitally defined pressure pulse (thermally, piezoelectrically, magnetically, biological) forces the fluid meniscus out of a nozzle and into contact with a substrate surface. See Speakman, col. 1, lines 56-64. Although in col. 36, lines 39-40 Speakman mentions that an "electrostatic spray head may be used," no structural details are provided. In col. 39, lines 60-65 Speakman mentions generating an electric field in the vicinity of the nozzle," but the droplet ejection is still done "by the actuators."

SAKAMOTO

Sakamoto discloses a printing method in which a solution is heated which causes bubbles. The liquid drops are jetted by expanding the heated bubbles.

Patentability of claims 1-10 under 35 U.S.C §103 (a)

Claims 1-10 stand rejected as being unpatentable over Natori in view of Speakman and Sakamoto. Reconsideration and withdrawal of this rejection are respectfully solicited in view of the claim changes made herein and in light of the following remarks.

Independent claim 1

Claim 1 has been amended herein to recite the step of "jetting liquid drops of the solution from the discharge port of the nozzle toward the surface of the base member by applying a voltage of an arbitrary waveform to the solution so that the solution is electrically charged."

The Examiner contends that Natori discloses forming an electronic circuit "by applying an electrical potential difference between the electrodes so as to supply a voltage of an arbitrary waveform to the solution to charge the solution (paragraphs 0021-0024)." See Office Action, page 3, lines 2-4. Applicants respectfully disagree with the Examiner on this issue. Nothing can be pointed to in the paragraphs specified by the Examiner which states that the solution is charged.

In one of the disclosed embodiments, Natori teaches applying an electrical potential difference *to a piezoelectric component* (PZT) 240. See Natori, paragraph [0018], lines 17-22. The PZT 240 is mounted on top of an ink head (21, 22) provided with a substrate 220, a nozzle plate 210 and a diaphragm 230. *Id.* In an assembled state, a nozzle 211, formed in nozzle plate 210, is in flow communication with a solution reservoir 223 via a cavity 221. *Id.* The diaphragm 230 is located between the top of ink jet head 22 and PZT 240. See Natori, FIG. 30. Actuated in response to a regurgitation signal Shx through a pair of electrodes, PZT 240 undergoes a mechanical distortion and generates a pressure wave propagating through diaphragm 230 and jet head 22 so as to cause cavity 221 to change its volume. See Natori, paragraph [0024].

Consequently, the deformed cavity 221 breathes out a drop of solution which traverses nozzle 211 on its way to a base member 100. *Id.* Thus, Natori teaches producing a mechanical force acting upon jet head 22 so that drops of solution are jetted out of nozzle 211.

In a further embodiment, Natori teaches using a heating element for heating the solution which expands so as to force a liquid drops from the nozzle. See Natori, paragraph [0019].

Thus, Natori does not teach applying a voltage to the solution so as to electrically charge it for jetting liquid drops from the nozzle, as recited in amended Claim 1.

Neither Speakman nor Sakamoto bridge the gap between claim 1 and Natori. Whereas Speakman mentions use of an electrostatic spray head, as pointed out above, it fails to teach applying a voltage to a solution, as recited in amended claim 1.

Sakamoto teaches a printing method in which discharging of liquid drops from a nozzle is caused by thermally expanding bubbles. Accordingly, Sakamoto, like Speakman, fails to teach jetting liquid drops from a nozzle by applying a voltage to a solution, as recited in claim 1.

Consequently, the applied combination of Natori, Speakman and Sakamoto fails to obviate the present claimed invention. Accordingly, claim 1 is allowable.

Independent claim 10

Claim 10 has been amended to recite "jetting liquid drops of the solution from the discharge port of the nozzle toward the surface of the base member by applying a voltage of an arbitrary waveform to the solution so that the solution is electrically charged." As the forgoing discussion has clearly shown, this feature is not disclosed, taught or suggested in Natori, Speakman and Sakamoto when applied individually or in combination. Accordingly, claim 10 is allowable over the applied references.

Dependent Claims 2-9

Claims 2-9 depend from claim 1 and, thus, benefit from its patentability. In addition, these claims include features which serve to even more clearly distinguish the invention over the applied references.

Conclusion

Based on all of the above, it is respectfully submitted that the present application is now in proper condition for allowance. Prompt and favorable action to this effect, and early passing of this application to issue, are respectfully solicited.

Should the Examiner have any comments, questions, suggestions or objections, the Examiner is respectfully requested to telephone the undersigned in order to facilitate reaching a resolution of any outstanding issues.

It is believed that no fees or charges are required at this time in connection with the present application; however, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,

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Amendments to the Drawings:

The reference numeral 30 has been used in the drawings to denote two different components, namely melting-sticking device 30 in Fig. 1 and bias power source 30 in Fig. 3. Accordingly, Fig. 3 has been revised to identify the bias power source with reference numeral 30'.

A replacement sheet for FIG. 3 is submitted herewith.

The specification has been conformed hereinabove to the revised drawings.